

Highlights

Characteristics of U.S. Higher Education Institutions

- ◆ **The defining characteristics of U.S. higher education today that foster access—a broad array of institutional types and sizes, public and private funding, and flexible attendance patterns—were already in place by the early 1950s.** The number of institutions of higher education, however, has doubled since the early 1950s: from approximately 1,870 to 3,700 in 1996. This large and diversified set of institutions provides an undergraduate education to nearly one-third of the U.S. college-age population. This access to higher education is still among the broadest in the world.
- ◆ **In the past 50 years, enrollment in U.S. higher education has grown from 2.5 million students to more than 14 million.** The four-decade expansion in enrollment in U.S. higher education reached its peak in 1992, when 14.7 million students were enrolled. Enrollment declined and leveled off from 1993 to 1996 and started to rise again in 1997. As the college-age population increases after the year 2000, enrollment in higher education is expected to rise again.
- ◆ **Although the diverse spectrum of institutions provides relatively high access to higher education in the United States, research-intensive universities produce the majority of engineering degrees and a large proportion of natural and social science degrees at the graduate and undergraduate levels.** The country's 126 research universities awarded more than 42 percent of all science and engineering (S&E) degrees in 1996 at the bachelor's level and 52 percent of all S&E degrees at the master's level.
- ◆ **Research universities are less prominent in the undergraduate S&E education of underrepresented minority groups than they are in the overall student population.** Black students receive their undergraduate S&E education mainly in comprehensive universities and liberal arts colleges. Historically black colleges and universities (HBCUs) still play a significant role in the undergraduate S&E education of black students.

Undergraduate S&E Students and Degrees in the United States

- ◆ **The relatively low level of mathematics and science proficiency of U.S. 12th graders is evident among entering first-year college students.** In 1997, 22 percent of first-year students who intended an S&E major reported that they needed remedial work in mathematics. In addition, 10 percent reported that they needed remedial work in the sciences. The need for remedial work in mathematics and science has remained high over the past 20 years, with some differences by field of intended major.
- ◆ **In the past two decades, the U.S. college-age population declined by more than 21 percent—from 21.6 million in 1980 to 17.0 million in the year 2000.** Trends de-

scribed in this chapter on decade-long declining enrollment and degrees in several fields of natural science and engineering (NS&E) reflect this demographic situation. The college-age population decline reverses itself in the year 2001, however, and increases to 19.3 million by the year 2010 (a 13-percent increase over the year 2000 figure). This increase in the college-age population portends another wave of expansion in U.S. higher education—and growth in S&E degrees at all levels.

- ◆ **Echoing this overall demographic decline, the number of students enrolling in undergraduate engineering decreased by 16 percent, from a high point of 441,200 students in 1983 to 356,000 in 1996.** This trend turned around slightly in 1997 and 1998, with a 1.5-percent increase in engineering enrollment. Trends in graduate engineering enrollment differ; graduate enrollment increased from 1979 to 1993 but has declined each year since.
- ◆ **Since the 1950s, trends in total undergraduate S&E degrees show continuous upward growth, although engineering, mathematics, and computer science fields show declining numbers of degrees in the late 1980s and the 1990s.** The growth in overall S&E degrees occurred in two waves: the first in the 1950s and 1960s and the second in the 1990s. The only fields with an increasing number of earned degrees in the 1990s have been psychology and biological sciences—fields in which women are highly represented. The entry of women into these fields has offset the overall demographic downturn.

International Comparison of First University Degrees in S&E

- ◆ **In 1997, more than 2.7 million students worldwide earned a first university degree in science or engineering.** Among reporting countries, more than 1 million of the 2.7 million S&E degrees were earned by Asian students within Asian universities. Students across Europe (including Eastern Europe and Russia) earned more than 750,000 first university degrees in science and engineering. Students in the North American region earned 500,000 first university degrees in these fields.
- ◆ **Some countries emphasize S&E fields in higher education more than others do.** In several large countries—Japan, Russia, and Brazil, for example—more than 60 percent of students earn their first university degrees in S&E fields, and in China, 72 percent do. In contrast, U.S. students study in a wide variety of non-S&E fields; they earn about one-third of their bachelor-level degrees in S&E fields (mainly in the social sciences).
- ◆ **Countries differ with regard to field emphases within science and engineering.** Engineering represents 46 percent of the earned bachelor's degrees in China, about 30 percent in Sweden and Russia, and about 20 percent in Japan and South Korea. In contrast, students in the United

States earn about 5 percent of bachelor-level degrees in engineering fields. Countries with high concentrations of university degrees in the natural sciences include Ireland (34 percent), France and India (about 20 percent), and the United Kingdom (18 percent). Natural sciences represent almost 12 percent of total U.S. bachelor-level degrees.

- ◆ **Among the major industrialized countries in the world, the United States is one of the leading nations in providing broad access to higher education.** In 1997, the ratio of the number of bachelor-level degrees to the 24-year-old population was 32 per hundred in the United States, 35 in the United Kingdom, 28 in Japan, and 24 in Germany. The ratios for Italy and France were 13 per hundred in that same year.
- ◆ **The United States ranks below many major industrialized and emerging countries, however, in the proportion of its college-age population with a natural science or engineering degree.¹** In 1997, the ratio of the number of NS&E degrees to the 24-year-old population in the United States was about 5 per hundred. This U.S. ratio has remained relatively constant—between 4 and 5—over the past several decades. In contrast, the ratio of NS&E degrees to the college-age cohort has been rising in other countries. South Korea and Taiwan dramatically increased their ratio of NS&E degrees to 24-year-olds: from 2 per hundred in 1975 to almost 7 per hundred in Taiwan in 1997 and almost 9 per hundred in South Korea. Among European countries, by 1997 this ratio had increased to 9 per hundred in the United Kingdom and 8 per hundred in Germany.

Graduate S&E Students and Degrees in the United States

- ◆ **One indicator of national innovation capacity and potential international competitiveness is the size and growth of graduate programs in science and engineering.** The long-term trend of increasing enrollment in U.S. graduate programs in S&E persisted for more than four decades, from the late 1940s to the early 1990s, followed by four years of declining enrollment since 1993.
- ◆ **Increases in S&E degrees at the master's level persisted for more than four decades, with accelerated growth in the first half of the 1990s and a leveling off in 1996.** Master's degrees in S&E fields expanded from the modest number of 13,500 in 1954 to more than 95,000 in 1996.
- ◆ **Doctoral S&E degree production in U.S. universities shows two waves of strong growth in the last half of the 20th century.** The first upsurge of total doctoral S&E degrees in the late 1950s and 1960s reflected the Cold War and the space race and was followed by a long, slow decline in NS&E fields in the 1970s and in the social sciences in the 1980s. In the 1980s, the second wave of growth occurred in NS&E fields with large annual increases in academic research and development (R&D) budgets. From

1986 to 1992, increasing numbers of foreign students entered these expanded graduate programs in NS&E fields.

International Comparison of Doctoral Degrees in S&E

- ◆ **The United States has the highest number of doctoral degrees earned in S&E fields.** In 1997, U.S. universities awarded about 26,800 S&E doctoral degrees—more than twice the number of S&E degrees awarded in any of the other major industrial countries. However, the combined doctoral S&E degrees of the three largest European countries (Germany, France, and the United Kingdom) recently reached 27,800, surpassing the number of such degrees earned within the United States.
- ◆ **Asian graduate education reforms are strengthening and expanding doctoral programs; consequently, some Asian countries are becoming somewhat less dependent on U.S. universities for advanced training in S&E.** In 1997, the number of S&E doctoral degrees earned within major Asian countries (China, India, Japan, South Korea, and Taiwan) exceeded 18,500—representing a 12-percent average annual increase from 1993 to 1997. In contrast, such degrees earned by Asian students from these five countries within U.S. universities peaked at 6,900 in 1996 (representing less than a 5-percent average annual growth rate from 1993 to 1996) and declined in 1997.
- ◆ **China has invested heavily in graduate education.** While the number of S&E doctoral degrees earned by Chinese students within U.S. universities showed a decade-long increase until 1996, the number of such degrees earned within Chinese universities continued to increase, and at a faster rate. By 1997, Chinese students earned more than twice as many S&E doctorates within Chinese universities as within U.S. universities.

Diversity Patterns in S&E Enrollment and Degrees in the United States

- ◆ **The trend of increasing enrollment in undergraduate programs by underrepresented minorities (including black, Hispanic, and American Indian/Alaskan Native students) has persisted for more than a decade and continued in the 1990s.** Black enrollment increased 3 percent annually from 1990 to 1996, reaching 1.4 million in 1996. Black males have had more modest gains than black females. In the same period, Hispanic enrollment in higher education increased at an even faster rate (7.7 percent annually). The strongest growth, however, has been among Asians/Pacific Islanders (8 percent annually)—minority groups that are not underrepresented in S&E fields.
- ◆ **Despite the overall trend of decreasing enrollment in undergraduate engineering in the past two decades, underrepresented minority groups increased their enrollment in such programs during this same time period.** The number of minority students enrolled in engineering increased from 28,700 in 1979 to 56,900 in 1998—an average annual increase of 3.7 percent. By 1998,

¹ Natural sciences and engineering include physical, earth, atmospheric, oceanographic, biological, and agricultural sciences; mathematics and computer science; and all fields of engineering.

underrepresented minorities represented 15.5 percent of engineering enrollment at the undergraduate level (up from 7.8 in 1979).

- ♦ **Compared with other groups, fewer underrepresented minority students complete a bachelor's degree within five years after beginning an S&E major.** In a longitudinal study, 47 percent of whites and Asians/Pacific Islanders completed an S&E degree within 5 years, compared with 25 percent of underrepresented minority groups. However, a larger percentage of underrepresented minority groups persisted in studying for an S&E bachelor's degree beyond five years. (Taking longer may reflect working part-time.) In addition, underrepresented minority groups switched to non-S&E majors more often than other groups. Attrition rates (dropping out of college) are similar across all groups—about 22 percent.
- ♦ **Students from underrepresented minority groups earn a higher proportion of degrees at the associate's level than in four-year or graduate programs.** In 1996, these students earned about 23 percent of the mathematics and computer science degrees at the associate's level, a far higher percentage than for such degrees earned at the bachelor's or advanced levels of higher education. At advanced levels, the proportion of degrees earned by underrepresented minorities drops off in fields of NS&E.
- ♦ **The United States is among the leading countries in the world in the proportion of first university S&E degrees earned by women.** By 1996, women earned 60 percent of the social and behavioral science degrees, 47 percent of the natural science degrees, 46 percent of the degrees in the mathematical sciences, 28 percent of the degrees in computer sciences, and 18 percent of the degrees in engineering. Women in the United Kingdom earn a similarly high proportion of S&E degrees. In contrast, in Japan women earn a smaller proportion of such degrees: 25 percent of natural science degrees, 23 percent of mathematics and computer science degrees, and 8 percent of engineering degrees.
- ♦ **Although low participation rates for blacks and Hispanics changed little throughout the 1980s, they have improved somewhat in the 1990s.** The ratio of college degrees earned by black students to their college-age population increased from 11 per hundred in 1980 to 18 per hundred in 1996; the ratio for Hispanic groups increased from 10 per hundred in 1980 to 14 per hundred in 1996. The ratio of NS&E degrees earned by black students to their college-age populations increased from 1 per hundred in 1980 to 2 per hundred in 1996, and the ratio for Hispanics rose from slightly under 2 per hundred in 1980 to slightly more than 2 per hundred in 1996. Even with these modest increases in the 1990s, however, participation rates of underrepresented minorities are approximately one-half the overall national rates.
- ♦ **For the period 1983–92, the strong growth in enrollment in U.S. graduate programs in S&E depended on the entry of foreign students, particularly in programs of natural science and engineering (NS&E).** In 1992, at the peak of their enrollment in U.S. graduate programs, foreign students represented one-third of the students in engineering, mathematics, and computer sciences. From 1993 to 1996, foreign graduate student enrollment declined at an average annual rate of 3 percent, with a slight upturn in 1997. The slight drop in doctoral degrees in NS&E fields in 1997 is mainly attributable to the decline in the number of foreign doctoral recipients in that year.
- ♦ **Among underrepresented minority groups, males are not as prevalent in fields of NS&E; women in these groups have a higher proportion of graduate enrollment compared with the overall average.** For example, women are one-third of the black graduate students in engineering and more than one-half of the black graduate students in fields of natural sciences. Black males are extremely underrepresented in U.S. higher education in general and in S&E fields in particular.
- ♦ **Gender equity in S&E degrees at the master's level has improved continually during the past four decades.** By 1996, women earned 58 percent of the master's degrees in the social and behavioral sciences and 49 percent in the biological sciences. However, they earned only 27 percent of computer science degrees and 17 percent of those in engineering. Degrees earned by males have declined in engineering for the past two years, mainly because of declining engineering enrollment by foreign students.
- ♦ **Each year from 1986 to 1996, an increasing number of foreign students earned S&E doctoral degrees from U.S. universities.** The number of such degrees earned by foreign students increased far faster (8 percent annually) than those earned by U.S. citizens (2 percent annually). This decade-long trend of increasing numbers of S&E doctoral degrees earned by foreign students halted in 1997. In that year, the number of degrees earned by foreign doctoral students dropped by 15 percent.
- ♦ **Like the United States, the United Kingdom, Japan, and France have a large percentage of foreign students in their doctoral S&E programs.** In 1997, foreign students earned 45 percent of the doctoral engineering degrees awarded within U.K. universities, 43 percent of the doctoral engineering degrees within Japanese universities, and 49 percent of the doctoral degrees within U.S. universities. In that same year, foreign students earned more than 21 percent of the doctoral degrees in the natural sciences in France, 29 percent in the United Kingdom, and 36 percent in the United States.
- ♦ **About 53 percent of the foreign students who earned S&E doctorates from U.S. universities in 1992 and 1993 were working in the United States in 1997.** The stay rates are higher for scientists and engineers from developing countries such as China (92 percent) and India (83 percent). In contrast, stay rates are lower for those from emerging economies such as Taiwan (36 percent) and Korea (9 percent) that can absorb highly qualified, skilled scientists and engineers.